

OTS: 60-41,694

JPRS: 5948
25 October 1960

DATA ON THE QUANTITATIVE DISTRIBUTION OF BOTTOM
FAUNA ON THE FLOOR OF THE ATLANTIC OCEAN

By A. Kuznetsov

- USSR -

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NEW YORK 17, N. Y.

JPRS: 5948
CSO: 3964-N/b

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/Following is the translation of an article by A. Kuznetsov entitled "Dannyye po kolichestvennomu raspredeleniyu donnoy fauny lozha Atlanticheskogo okeana" (English version above) in the Oceanology section of Doklady Akademii Nauk SSSR (Proc. Acad. Sci. USSR), Vol. 130, No. 6, 1960./

(Submitted by Academician V. N. Sukachev, 10 November 1959)

Study of the quantitative distribution of bottom fauna in the vast stretches of the ocean is one of the most important departments of our knowledge of the distribution of life in the world's oceans.

In recent years (1949 to 1959), expeditions on the "Vityaz'" and "Ob'" took systematic quantitative samplings of bottom fauna in the Pacific and Indian Oceans and in the waters of the Antarctic. The data obtained made it possible to detect certain laws operating in the distribution of life on the ocean floor, and to draw up a map showing the quantitative distribution of bottom fauna for wide areas of the floor of the Pacific and Indian Oceans /3/.

As for the Atlantic Ocean, however, our data on

the quantitative distribution of the bottom fauna were limited to only a few bottom-grab samples obtained by the expedition on the "Galateya" near the coast of equatorial Africa /4/.

During the operations of the 5-th Atlantic expedition on the vessel "Mikhail Lomonosov" (April to July 1959), whose basic assignment was to study the latitude-zone distribution of the physical-chemical and biological characteristics of the Atlantic Ocean, we collected material on the quantitative distribution of bottom fauna along the 30-th meridian. The collection of the material was carried out in the period from 22 April through 31 May, using an "Okean 50" bottom grab with an aperture area of 0.25 m^2 .

Quantitative bottom-grab samples were taken at 21 stations*, of which 18 were located on the 30-th meridian from 67° N to 21° S , 2 at 60° N , south of Iceland, and 1 off the coast of Brazil (Fig. 1).

The majority of the samples (14 out of 21) were obtained at depths greater than 2,000 m. The samples were washed in a net made of #140 gauze. The fauna which they

* A qualitative sample was taken at Station No. 361a.

** It was impossible to make a more detailed determination of the systematic composition of the fauna on the ship.

contained were broken down into groups,** fixed in 80° alcohol, and, about a month after fixation, were weighed to determine the total biomass of the bottom fauna and the biomass of the animal groups composing it.

The material which we collected made it possible to bring to light certain characteristics of the quantitative distribution of bottom fauna in the northern half and part of the southern half of the Atlantic Ocean along the 30-th meridian, and to trace a relationship between the meridional distribution of certain abiotic factors (bottom contours, dynamics of the waters, nature of the soils, abundance of food) and the development of bottom life at different latitudes.

It will be seen from Table 1, in which we present the actual data on the composition and biomass of the bottom fauna at the stations, that the quantitative distribution of fauna on the bottom of the Atlantic Ocean along the 30-th meridian is extremely uneven. The total biomass of the fauna fluctuates from 0* to 2,000--3,000 g/m² and higher for different regions. The weakest quantitative development of bottom fauna is observed south of

* It must be noted that in current quantitative studies of the sea-bottom fauna, we take into account only macrofauna, disregarding the microfauna. Therefore the 0 indices cannot yet be taken to signify the total absence of life.

10° S (southern part of Brazil trough). In this region, the bottom grab filled up at depths of 4860 and 5400 meters (stations No. 388 and 384) with red clay, on the surface of which we identified only isolated bottom foraminifera. There were no macrofauna in the samples.

Table 1

[Table 1. On page 4b]

1) COMPOSITION AND BIOMASS OF BOTTOM FAUNA IN THE ATLANTIC OCEAN (ON THE BASIS OF QUANTITATIVE BOTTOM-GRAB SAMPLES TAKEN ON THE 5-th VOYAGE OF THE "MIKHAIL LAMONOSOV");
2) Station No.; 3) Coordinates; 4) Depth (meters); 5) Sponges; 6) Coelenterates; 7) Worms; 8) Mollusks; 9) Crustaceans; 10) Bryozoans; 11) Echinoderms; 12) Ascidians; 13) Others; 14) Total biomass; 15) N; 16) S; 17) W; 18) In grams on 1 m².

№ станции	Координаты	Глубина в м	в граммах на 1 м³										
			Глубина	Кислород	Нит	Черная	Молочная	Растительная	Мшанки	Иглокожные	Желе	Асцидии	Прочие
341	60°00'0" с.ш., 21°44'0" з.д.	1790	—	—	—	0.54	0.26	0.11	—	12.8	—	0.08	0.11
342	60°00'0" с.ш., 21°44'0" з.д.	2881	—	—	—	—	0.26	0.03	—	—	—	—	12.85
343	60°00'0" с.ш., 21°44'0" з.д.	960	—	—	—	—	0.6	0.6	—	—	—	—	3803.6
344	60°00'0" с.ш., 21°44'0" з.д.	326	—	—	—	1.6	0.6	0.6	—	12.1	—	0.04	81.44
345	60°00'0" с.ш., 21°44'0" з.д.	347	—	—	—	2.6	1.5	2.1	—	5.4	—	—	10
346	60°00'0" с.ш., 21°44'0" з.д.	347	—	—	—	22.7	1.5	0.16	—	—	—	—	22.86
347	60°00'0" с.ш., 21°44'0" з.д.	2022	—	—	—	—	—	—	—	3.4	—	—	2842.8
348	60°00'0" с.ш., 21°44'0" з.д.	1978	—	—	—	0.03	—	—	—	—	—	—	1.01
349	60°00'0" с.ш., 21°44'0" з.д.	2338	—	—	—	2.0	0.11	0.03	—	2.7	—	—	4.84
350	60°00'0" с.ш., 21°44'0" з.д.	2338	—	—	—	0.35	0.11	0.03	—	—	—	—	0.56
351	60°00'0" с.ш., 21°44'0" з.д.	3318	—	—	—	0.22	0.12	0.01	—	—	—	—	0.23
352	60°00'0" с.ш., 21°44'0" з.д.	2516	—	—	—	1.4	0.12	4	—	—	—	—	97.62
353	60°00'0" с.ш., 21°44'0" з.д.	715	—	—	—	0.03	0.12	0.10	—	—	—	—	0.35
354	60°00'0" с.ш., 21°44'0" з.д.	3055	—	—	—	0.03	0.12	0.10	—	—	—	—	0.07
355	60°00'0" с.ш., 21°44'0" з.д.	2055	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
356	60°00'0" с.ш., 21°44'0" з.д.	4055	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
357	60°00'0" с.ш., 21°44'0" з.д.	4779	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
358	60°00'0" с.ш., 21°44'0" з.д.	5370	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
359	60°00'0" с.ш., 21°44'0" з.д.	3255	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
360	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
361	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
362	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
363	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
364	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
365	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
366	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
367	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
368	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
369	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
370	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
371	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
372	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
373	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
374	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
375	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
376	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
377	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
378	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
379	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
380	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
381	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005
382	60°00'0" с.ш., 21°44'0" з.д.	5400	—	—	—	0.03	0.12	0.10	—	—	—	—	0.005

We also observed extremely weak qualitative development of the bottom fauna between 20 and 30° N in the region of the North Atlantic trough, where depths of 4,000 meters and more predominate and where, just as in the Brazil trough, deep-water red clay occurs extensively. In bottom grabs pulled up from this region, we found 1 sipunculid (Station No. 367) and 1 polychaete (Station No. 364), each weighing 5 mg.

The reasons for this extremely weak development of bottom life in the North African and particularly in the Brazil troughs, which is not even equaled in the regions of the Pacific and Indian Ocean floors which are deepest and farthest from any coast line /3/, are not entirely clear. The most probable cause is to be sought in the fact that the two troughs are located within the region of propagation of the northern (first) and southern (second) central water masses of the Atlantic Ocean, which are characterized by sharply expressed stratification and extremely low indices for the quantitative development of pelagic life in the surface layers. Also of extremely great importance is the fact that both of these regions are remote from the main currents of the central Atlantic Ocean-- the Canary, northern and southern Trade, and Brazil currents--and coincide with the halistatic regions

located to the north and south of 15° -- 20° of northern and southern latitude, respectively.

In the equatorial part of the ocean (between 4° and 12° north)--in the region of the tropic currents and the emergence of the deep tropospheric waters to the surface--the bottom fauna attains higher quantitative development indices than in the two regions discussed above. Even on red clay and at depths greater than 5,000 m, the biomass of the benthos rises noticeably here, and is measured in tens (Station No. 372), while on the slopes of the north Atlantic ridge, which is covered with globigerina ooze, may even be reckoned in hundreds of milligrams on one m^2 .*

The presence of polychaeta (phylum Phyllochaetopterus), the beaks of squid, and the teeth of sharks/dogfish?/ in the samples taken from this region merits attention. A development of plankton in the surface layer from 0 to 100 m on a more abundant scale than in the preceding regions is also characteristic (according to the data of the Plankton Division on the 5-th voyage of the "Mikhail Lomonosov").

* We regard the enormous (3.35 g) sipunculid specimen found at Station No. 375 as accidental.

Lomonosov" and bathythermograph indications, the stratospheric waters ascend toward the surface of the ocean, we recorded a biomass of 97.6 g/m^2 (Station No. 361) composed of sponges, hydrozoa, hermit crabs, small gastropod mollusks (*Retusa*, *Cylichna*, *Hydrobiidae*, *Margaritacea*) and the polychaete *Onuphis*. Also present in the sample were shells of the above gastropod mollusks (11 specimens), valves of the bivalve mollusks (20 specimens), the remains of solitary *Madreporaria* (about 40), the armor of small porcupine fish (about 20 specimens), and a tube of a polychaete of the family *Serpulidae*. To the north of the Azores, in the region of the north Atlantic current (between 40° and 60° N), which passes over depths of 2500 to 3000 m and more in this part of the ocean, the bottom-fauna biomass again drops sharply. Here, however, it does not fall below 230 mg/m^2 , attaining $1\text{--}5 \text{ g/m}^2$ at Stations No. 352 and 354, where the bottom rises to 2836--2382 m.

The bottom fauna attains particularly high quantitative-development indices to the north of 60° N , in an area coinciding with the regions of the subarctic convergence --the interaction of relatively warm north Atlantic waters with cold Arctic waters--i.e., with those regions of the ocean which are characterized by intensive agitation of the waters, high concentrations of biogenic elements,

and abundant development of pelagic and bottom life.

Also most characteristic for this area are the colossal accumulations of sponges, which form a biomass of 2000 to 3000g/m² and higher at depths exceeding 1,000 m; this is reminiscent of the shelf areas of the Antarctic /1/ and the southwestern reaches of the Barents Sea /2/.

The occurrence of such a large number of sponges at depths of 1,000 meters and more is an extremely interesting fact, indicating a very rapid process of descent of surface waters of the ocean that are rich in nutritive materials (dead plankton). In no other region of the world's ocean has such an abundant development of sponges been observed at such great depths.

In this manner, the floor of the Atlantic Ocean along the 30-th meridian can be divided into two parts (Fig. 2) in accordance with the quantitative development of its bottom life: into a part in which the waters are deepest and extremely impoverished (with a certain increase in the biomass in the equatorial zone of the ocean) located in the region of propagation of the low-production central Atlantic waters (south of 30° N), and a northern part (north from 30° N) which is shallower and richer with respect to the quantitative development of its bottom life and has two areas of profuse development of bottom fauna--

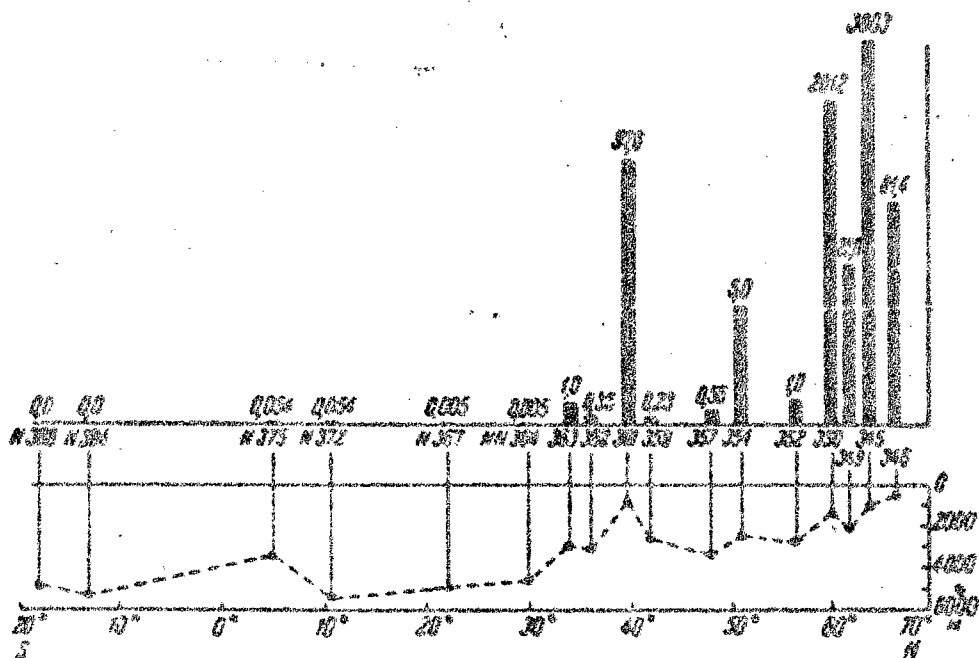


Fig. 2

Distribution of bottom-fauna biomass on the floor of the Atlantic Ocean along the 30-th meridian (according to data of the 5-th voyage of the expeditionary vessel "Mikhail Lomonosov").

the region from 60 to 67° N, which coincides with the region of the subarctic convergence, in which the bottom fauna attains particularly high quantitative-development indices, and an area from 38 to 40° N, in which the increased development of the fauna is due to the proximity of the Azores and the emergence of deep stratospheric waters at the surface.

Table 2

	Число станций	Глубина в м	Биомасса в г/м ²
67—60° с.ш.	2	2351 (2022—2681)	17,8 (12,7—22,9)
60—40° с.ш.	4	2778 (2382—3318)	1,6 (1,2—5,4)

1) North latitude; 2) Number of Stations; 3) Depth in meters; 4) Biomass in g/m².

The decline in the bottom-fauna biomass at similar depths can be traced easily in the latter (northern) part as we proceed from north to south (see Fig. 2 and Table 2).

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of the USSR

Received
1 November 1959

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